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April 25, 2020

Judge: Michael H. Watson
U.S. Courthouse, Room 108
85 Marconi Boulevard
Columbus, OH 43215

Re: IN THE UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO EASTERN DIVISION
John Doe, et al., : Case No.: 2:91-cv-00464 Plaintiffs, : Judge: Michael H. Watson
v. : Magistrate Judge: Chelsey M. Vascura

Dear Judge Watson;

I have enclosed several communications I have sent to all of the interested parties in the above cited case. I have heard back only from one of the plaintiffs, expressing appreciation for the arguments I was making.

In summary, the structure of the approach has some significant methodological problems. Your goal, I assume, is to demand that the schools produce better and more meaningful results for the special education child. However, the method by which they have decided to address your concerns has some problems. 1) They haven't changed the basic approach of employing IEP reports to structure the individual interventions, despite evidence that this approach has not been able to produce consistent and significantly reliable results. Thus, they are using the same approach and hoping it will produce different results. This is Einstein's definition of insanity. Any change in the approach will be guided by the individuals engaged in the intervention in the school system, not by any standardized measure to gauge changes. Unfortunately, this approach is tainted by observer bias and problems with eyewitness testimony and thus is unreliable as a scientific measurement tool. 2) They are relying on standardized achievement measures to measure the results. They should be focusing on ability. As there is a correlation between achievement and ability, it is ability that is critical for the child to succeed in life. As a loose analogy, one can teach 1+1=2 for 30 x until the child achieves that knowledge. A change in ability renders the achievement gain accessible in one exposure. The EEG biofeedback approach I was encouraging them to explore changes ability and achievement follows. It is improvements in ability that will allow the child to function better with the challenges of life.

I don't expect anything to change at this point. However, when they come back to you in 3 years with no significant or minimal progress you will have the information to ask them why they didn't proceed with a different more effective method rather than rely upon what they have been doing for years.

Sincerely;

Kirtley Thornton, PhD

Ψ K. E. Thornton

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April 6, 2020

Re: Memory problems, Brain Injury, Learning disabilities, Dyslexia, ADD, cognitive problems in children, prison population

I received the following email from a client recently after her son had engaged in about 40 hours of EEG biofeedback intervention.

"I got a report on my son from his school. Beginning of 4th grade he was reading at a kindergarten level, now he is reading at a 2nd grade level with 98% accuracy and they predict he will be at 3rd grade level by the end of January! 😊" A very heart-warming email.

All men and women are created equal. Not all brains are created equal. For the past 25 years, I have been working on the problem of how to improve brain function with the use of EEG biofeedback and a patented cognitive activation database. The data reported (Table 1) below reflect my progress (Thornton & Carmody, 2013). I believe your organization can improve the effectiveness of your interventions by employing what I will be discussing.

The memory improvement results are significantly better than the average results of tutoring programs (~.46 Standard Deviations (SD), computer interventions (~ .61 SD) and cognitive rehabilitation programs (~.26 SD).

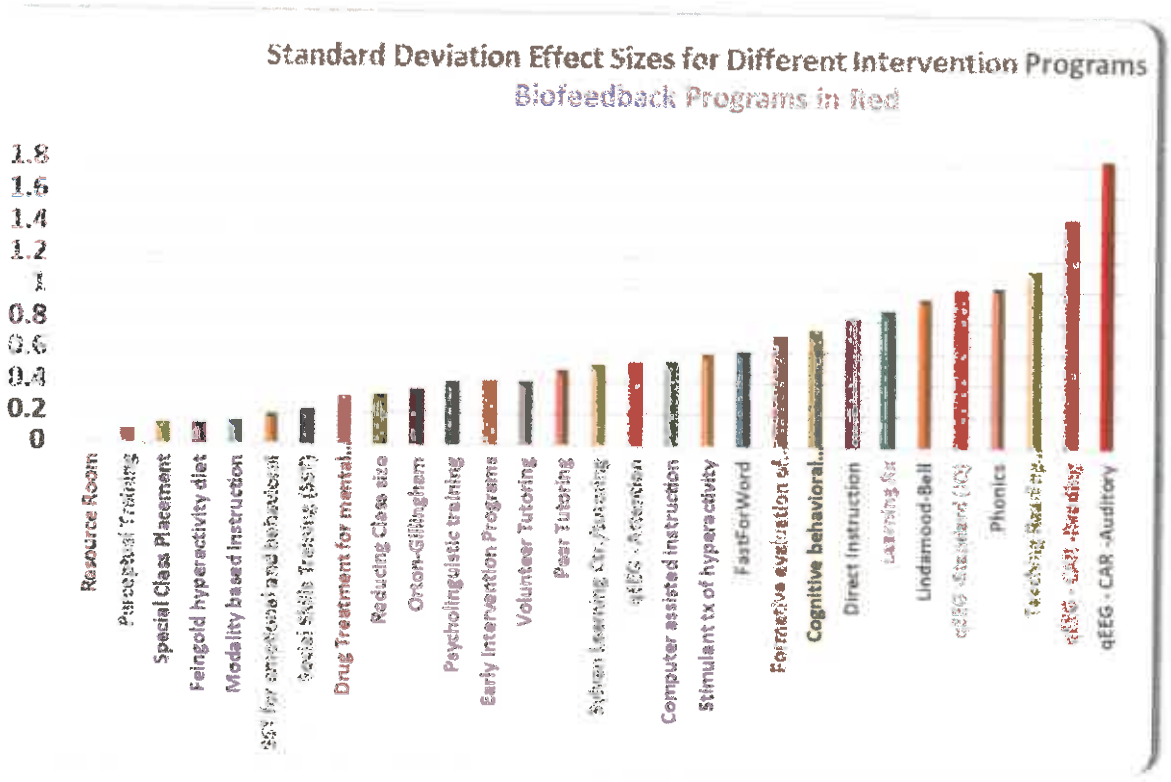
Table 1

	Auditory Memory SD Effect	Auditory % Effect	Reading Memory - SD Effect	Reading% Effect
Normal (n=12)	1.66	59%	1.29	101%
TBI (N=36)	2.3 (N=36)	105% (n=14)	1.85	143%
Adult SLD (N=17)	1.42	86%	1.71	219%
Child SLD (n=14)	1.28	74%	1.38	225%
Total (avg) N=79	**1.09**	**81%**	**1.56**	**172%**

TBI=Traumatic Brain Injury SLD=Specific Learning Disability SD=Standard Deviation
For comparison purposes, 1 SD of weight is 30 lbs.

In addition, all the groups were performing above their respective normative reference group memory performances, thus "cured" of their memory problems; a statement no other intervention models are able to make. A control group (N=15) showed no improvement over 15 stories administered. In addition, there were significant changes in the values of the QEEG's communication variables (coherence and phase) averaging a little under 2 SD (N=59) and arousal variable (32-64 Hz). Thus, documented changes in the physical functioning of the brain have been established. Figure 1 compares the EEG approach to other currently employed intervention models.

Figure 1



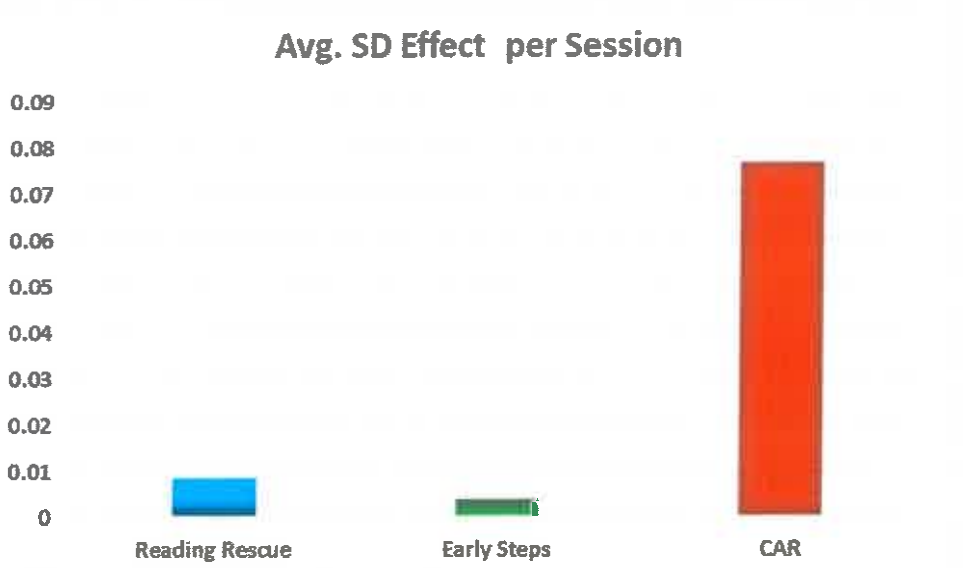
The red bars present the results of different EEG biofeedback programs. Only the last two red bars (CAR) employ very specific EEG intervention protocols which address the dysfunctional areas and connections as revealed in the activation QEEG evaluation. The average # of sessions was 45 or about 23 hours.

The special education interventions offered over the past several decades have not shown the results we need in this area. Part of the problem resides in the fact that there are underlying neurobiological problems driving these problems (Eden & Zeffiro, 1998, Ramus, 2004, Shaywitz, 2004) which aren't being specifically addressed with commonly used intervention programs. The McCandliss and Noble (2003) review pointed to a problem in the superior temporal gyrus and left occipito-temporal extrastriate visual system in dyslexia. The history of interventions can be conceptualized as "outside" interventions as they characteristically change the environment the child is exposed to with specially designed interventions. These interventions are hoped and thought to be able to change the underlying problem in brain functioning which is resulting in cognitive problems. Thus, tutoring type interventions will focus on strategies, computer interventions and a host of other external stimulation approaches. However, this basic approach has shown to produce similar results no matter what external stimulation is being employed.

For example, Ritchey and Goeke (2006) reviewed 12 Orton-Gillingham (OG) based studies and found mixed results. What Works Clearing House (WWC) reported that the OG did not meet its standards (U.S. Department of Education, Institute of Educational Sciences (IES), 20010a). The Wilson reading system is a derivative of the OG method. The Wilson program is implemented over a 1-3 year period in a 12 step sequence (Wilson & O'Conner, 1995). Wood (2002) reported a .38 SD improvement on the Woodcock Reading Master Test total reading cluster over a 1 year intervention period which included subtests of Word Identification, Word Attack, Passage Comprehension, & Basic Skills. The WWC reviewed 9 studies and concluded that the Wilson Method may have a positive effect on a student's understanding of alphabetic principles but little effect on fluency and comprehension. The Lindamood-Bell intervention program (2005) reported gains of .60 SD on

word reading and .35 SD on sentence/paragraph reading after one year of instruction. WWC reviewed one study using the Lindamood Phonemic sequencing and found possible benefits on alphabetic principles and reading fluency and possible negative effects on writing skills. Bentum & Aaron (2003) assessed the effect of resource room reading instruction after 3 years (N=230) and 6 years (N=64) of instruction. Pre- and post- test reading achievement and IQ scores were obtained for both groups. The results indicated no improvement on word recognition or reading comprehension and a decrease in spelling scores. The 6 year group demonstrated a decrease on verbal IQ measures. Additionally, the Fast ForWord program has not proven to be effective for reading improvement (Strong, Torgerson, Torgerson & Hume (2011). A recent review of reading programs is available on the internet at https://www.evidenceforessa.org/programs/reading/elementary. The review covered 66 programs with an average effect size of .27 SD. (range 0-.87). Reading rescue (SD=.89) costs $10-$15 K a year for about 95 30 minute sessions. Early steps (.86 SD) requires 190 30 minute sessions. The Car EEG intervention results reported are for 45 sessions. Figure 2 shows a comparison of the standard deviation effect size across the Reading Rescue, Early Steps and the EEG bio (CAR) intervention models.

Figure 2 – Average Standard Deviation Effect Per session per model

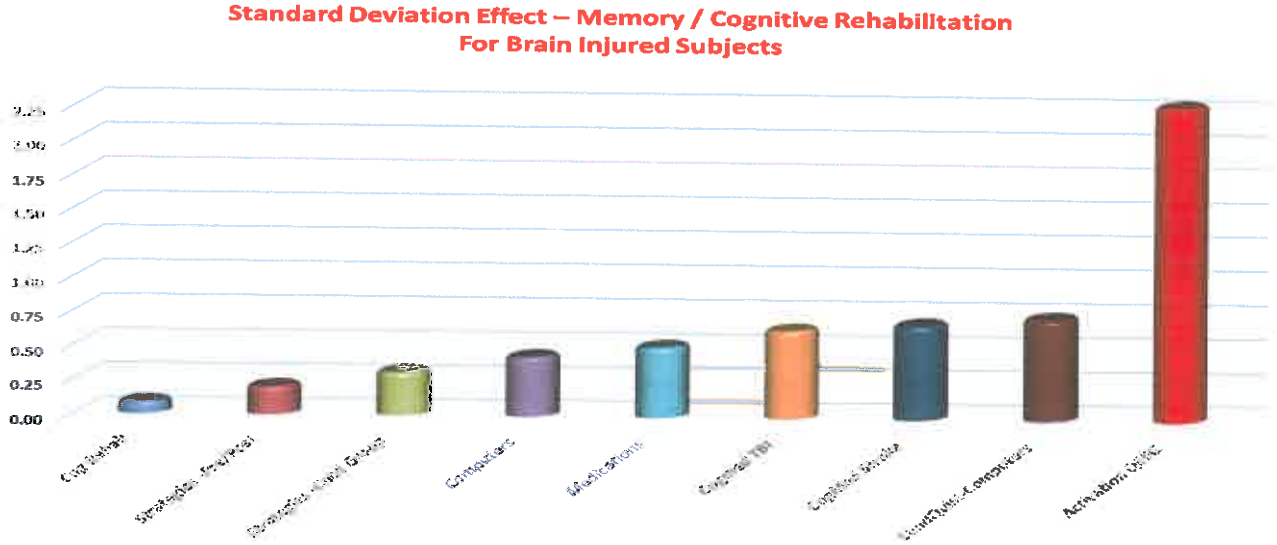


The problem is not in the individuals employing these methods, but the methods are not an effective way to approach the problem. The pattern across these studies and many more is that these "outside" approaches do have some effect, but are insufficient to fix the basic problem in brain functioning, which is an "inside" problem. The "inside" approach is characterized by the EEG biofeedback approach, which attempts to change the underlying electrophysiological signals.

A review of this area is available at http://neuroeducation.co/no-child-left-behind/ as well as an compilation of articles addressing specific QEEG correlates of a number of cognitive skills across two age groups (child, adult) at http://neuroeducation.co/how-the-cognitive-brain-works-the-quantitative-eeg-and-cognition/

Figure 3 shows a comparison with different approaches for the head injured subject.

Figure 3

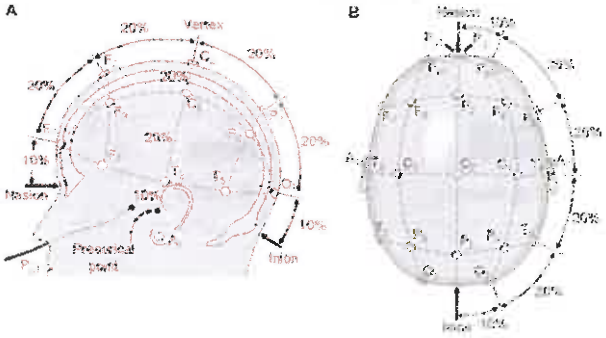


Thornton & Carmody (2009), Thornton & Carmody (2013), Hellgren et al. (2015), Lundqvist et al. (2010), Rohling et. al. (2009).

What is the QEEG?

Figure 4 shows how the sensors are placed on the head.

Figure 4: The 10-20 system



The quantitative EEG (QEEG) involves the digitization of the analog EEG signal, a technology developed during the 1990s. There have been thousands of research articles published in this area during the past 3 decades. The QEEG looks at some 2000 variables involved in two areas: arousal and communication across 4 frequencies (delta: 0-4 Hz; theta: 4-8 Hz; alpha: 8-13 Hz; beta1: 13+ Hz; beta2; 32-64 Hz). The biofeedback approach employs operant conditioning (rewarding/inhibiting) of the EEG signal. Operant conditioning is a heavily researched intervention method. Tutoring involves the same concept as it rewards the student for producing the correct response and discourages the student from an incorrect response. The difference resides in whether we are rewarding/inhibiting verbal or other output from the student or their electrophysiology.

Initial EEG biofeedback approaches have focused on the arousal variables (theta – beta microvolts). Four studies showed average gains of 15 points on standard IQ measures (WAIS, WISCR, etc.) (Tansey, 1991; Linden et al., 1996; Thompson & Thompson, 1998); Othmer & Othmer, 1992). Other research has focused on the coherence relationships. For example, Coben, Wright, Decker and Morgan (2015) reported average

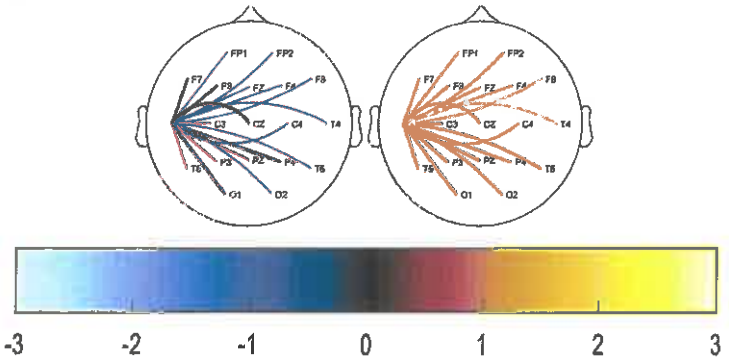
improvements of 1.2-grade levels in reading scores following two channel coherence neurofeedback over the left hemisphere (20 sessions, N=42 learning disabled students). There were no changes in the control group (typical resource room instruction). They employed eyes closed and eyes open data to guide the interventions towards the low coherence connections in the left hemisphere, mostly the occipital-parietal to frontal-temporal regions in the delta, theta and alpha frequencies. Inhibit feedback on the delta-theta amplitudes was also employed. These approaches do not address the brain as a total system, nor looks at the brain as it responds to specific cognitive tasks, nor examines the 32-64 Hz frequency range, nor looks at the variables involved in effective performance for specific tasks. Our approach examines all of these issues.

The research I have conducted has demonstrated that the Coordinated Allocation of Resource Model (CAR) is an appropriate way to view cognitive skills as it states that each cognitive skill employs a different set of resources (albeit overlapping in some cases) to effectively accomplish a task. We need to address the special education problem from this point of view. We cannot assume that tutoring approach A or B will selectively engage the appropriate resources, as we are not even sure what A or B is addressing from an electrophysiological point of view. We have effectively addressed both arousal and communication variables (Thornton, 2006; Thornton, K. & Carmody, D., 2013).

There are many other published research reports attesting to the positive effects of EEG biofeedback, which are too numerous to mention in this communication.

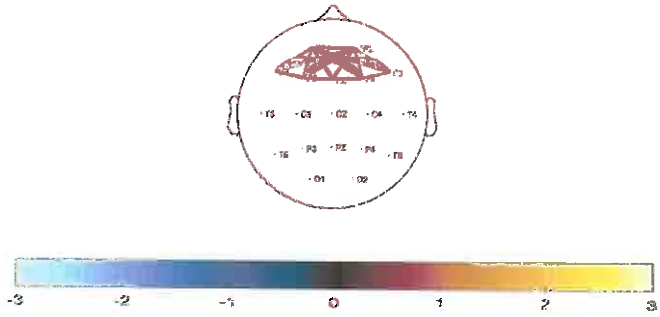
The problem the field faces is: What signal do we need to reward and what signal do we need to inhibit and regarding what cognitive skill? The power of the CAR approach is that it defines specifically the variables that are involved in cognitive performance and identifies the specific weaknesses in a subject. Most approaches in this field focus on inhibiting theta microvolts and increasing SMR beta microvolts along the sensori-motor strip. These variables are important but are not are the critical variables for cognitive improvements. For example, Figure 5 shows the coherence alpha values (color-coded – blue low – red /yellow high) for different subjects during an auditory memory task. The subject on the right would have a higher auditory memory score. The colored bar below the figure represents the standard deviation value in colors.

Figure 5 – Auditory Memory example T3 Coherence alpha



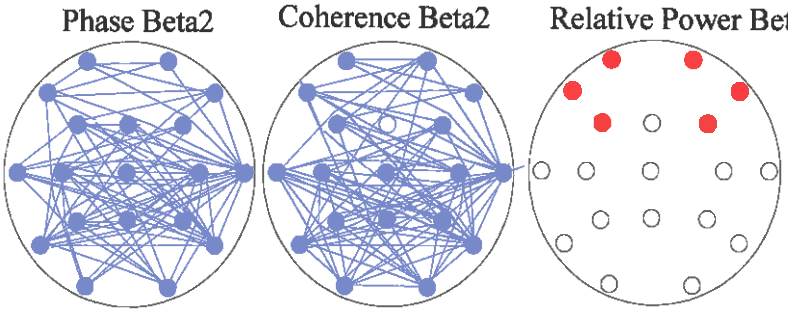
In the second example, we are looking at the ability to perform multiplication tables in a group of children (Figure 6). In this example, the better performing child had higher coherence and phase communication patterns in the frontal lobes in the alpha and beta frequencies. There were other variables involved, but are not presented in the interest of simplicity. Thus, the child who performed better was making the calculations in the frontal lobe and employing communication patterns in specific frequencies.

Figure 6 – Child's multiplication ability indicated in frontal lobe connection patterns



The QEEG can also address diagnostic questions, such as a head injury. Figure 7 presents the variables that are deficient in the head-injured subject. These mainly involve the communication patterns (coherence and phase) in the gamma frequency (32-64 Hz). In this figure, blue indicates below normal values, and red indicates above normative values.

Figure 7



CB2= Coherence (SCC) beta2 (32-64 Hz): PB2=Phase beta2; RPB2=Relative Power Beta2

Using these variables we have been able to obtain a 99% discriminant accuracy rate in differentiating brain injured from normal subjects (Thornton, 2014). There is no other published research that can match these results. The Veteran Administration is working on submitting a research proposal to follow up on this research.

Identifying Specific Electrophysiological Deviations

The value of the approach resides in its ability to define very specifically what are the deficits in electrophysiological functioning which can then be directly addressed with the EEG biofeedback approach. The approach has provided us with an improved QEEG microscope to understand brain functioning. With this technology, we can focus on specific areas of dysfunction for rehab purposes. Figure 8 below represent frontal lobe dysfunction and F7 low connection values in a patient. The view is from the top of the head looking down with the left ear on the left side and the nose on top. The connection values are expressed in standard deviation (SD) values follow the color coding presented below, with blue representing below average and red/yellow above average.

Figure 8

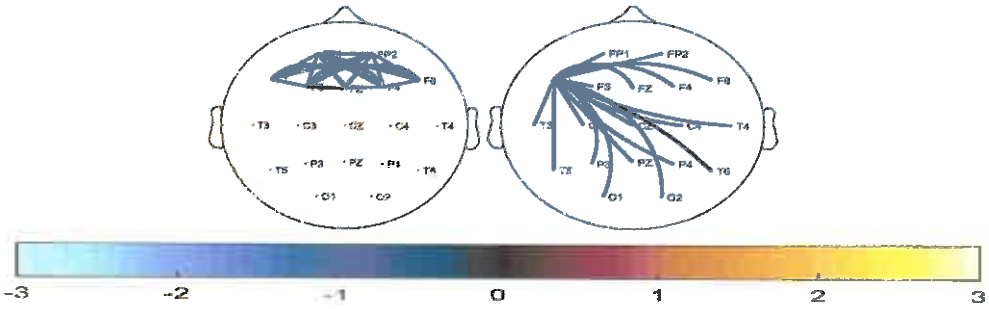


Table 2 shows a spreadsheet analysis of a patient who is demonstrating problems in frontal lobe beta2 (32-64 Hertz) connection patterns. The -1.01 (frontal CPU) value is the average SD value within the frontal lobes. The -.96 value on the bottom row represents the average SD value of the connection patterns emanating from the T3 location (left temporal lobe). Thus, this subject has problems in frontal lobe connection patterns and signals coming from the T3 location.

Table 2

Beta2	F1	F2	F7	F8	F3	F4	T3	T4	C3	C4	T5	T6	P3	P4	O1	O2	FZ	CZ
F2	-1.65			frontal cpu	-1.01		fCPU	0.48	CPU	0.68	PPU	0.49						
F7	-1.30	-1.31																
F8	-0.89	-1.59	-0.55															
F3	-1.63	-1.14	0.39	-0.26														
F4	-1.39	-2.45	-0.43	-0.82	-0.20													
T3	-0.34	-0.60	0.21	-0.51	-0.88	-1.06												
T4	0.54	0.17	0.89	-0.12	1.36	0.55	-0.26											
C3	-0.83	-0.56	0.25	-0.13	0.07	-0.37	-1.38	0.71										
C4	-0.33	-1.06	0.66	-0.60	1.50	-0.24	-1.08	0.70	0.89									
T5	0.03	-0.02	0.36	0.18	0.97	0.18	-1.35	0.64	1.58	0.69								
T6	0.27	0.00	0.75	-0.14	1.45	0.75	-1.00	0.72	0.70	1.39	-0.01							
P3	-0.18	-0.14	0.28	0.01	0.85	0.20	-1.54	0.78	0.50	0.67	0.55	-0.21						
P4	0.20	-0.07	0.76	-0.13	1.57	0.39	-1.31	0.72	1.03	0.77	0.38	-0.05	0.62					
O1	0.08	0.15	0.55	0.32	1.44	0.79	-1.45	1.13	1.24	1.26	-0.14	0.06	0.66	0.92				
O2	0.29	0.16	0.88	0.15	1.80	0.90	-1.20	0.96	1.50	1.30	0.36	-0.22	0.97	0.58	0.52			
FZ	-1.03	-1.58	0.32	-0.59	1.28	-0.92	-0.82	1.18	0.54	0.92	0.92	1.37	0.93	1.20	1.25	1.39		
CZ	-0.26	-0.72	0.64	-0.31	1.54	-0.26	-1.27	0.94	1.13	0.84	1.11	0.88	0.93	0.89	1.22	1.28	0.43	
PZ	-0.02	-0.11	0.59	-0.06	1.49	0.37	-1.48	0.88	1.33	0.79	0.45	0.14	0.83	0.26	0.84	0.67	0.85	0.49
tot ave	-0.47	-0.70	0.22	-0.34	0.59	-0.22	-0.96	0.72	0.45	0.54	0.38	0.41	0.37	0.48	0.60	0.68	0.43	0.53	0.44

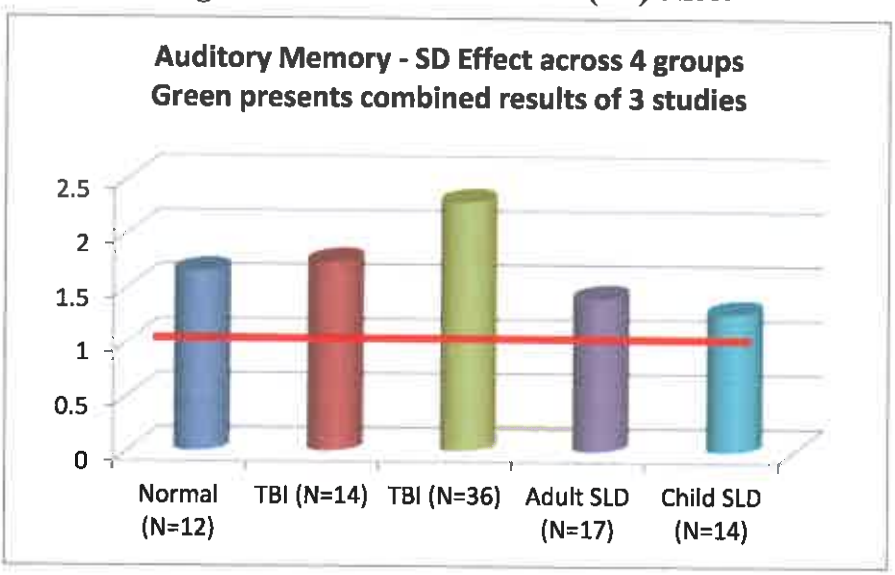
It is this level of statistical and technical precision that allows us to obtain the results we have achieved. This approach is significantly different from other currently employed EEG biofeedback models which focus on

SMR frequencies (12-18 Hz), don't examine the gamma frequency (32-64 Hz), don't examine cognitive activations tasks, and don't know the relationships between the QEEG variables and cognitive performance.

Specific Cognitive effects of the CAR approach.

The following figures show the specific effects of employing the CAR model with auditory and reading memory problems, both in terms of standard deviation changes and relationship to normative values. The average # of sessions was 45 (~23 hours). Once the correlates of a cognitive skill are understood, it is relatively straight forward to focus on the deficit functioning variables with the operant conditioning EEG biofeedback approach.

Figure 9 – Standard Deviation (SD) effect



TBI=Traumatic Brain Injury Adult SLD=Adult Specific Learning Disability Child SLD=Child Specific Learning Disability
Red line .80 SD effect size – considered a large effect

Figure 10

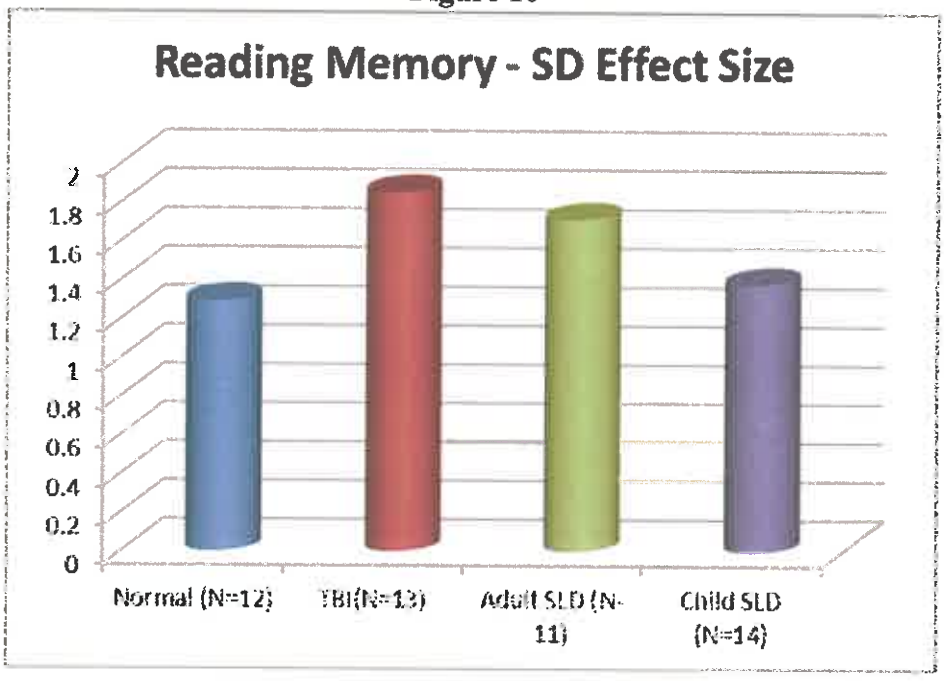


Figure 11 - % Improvement

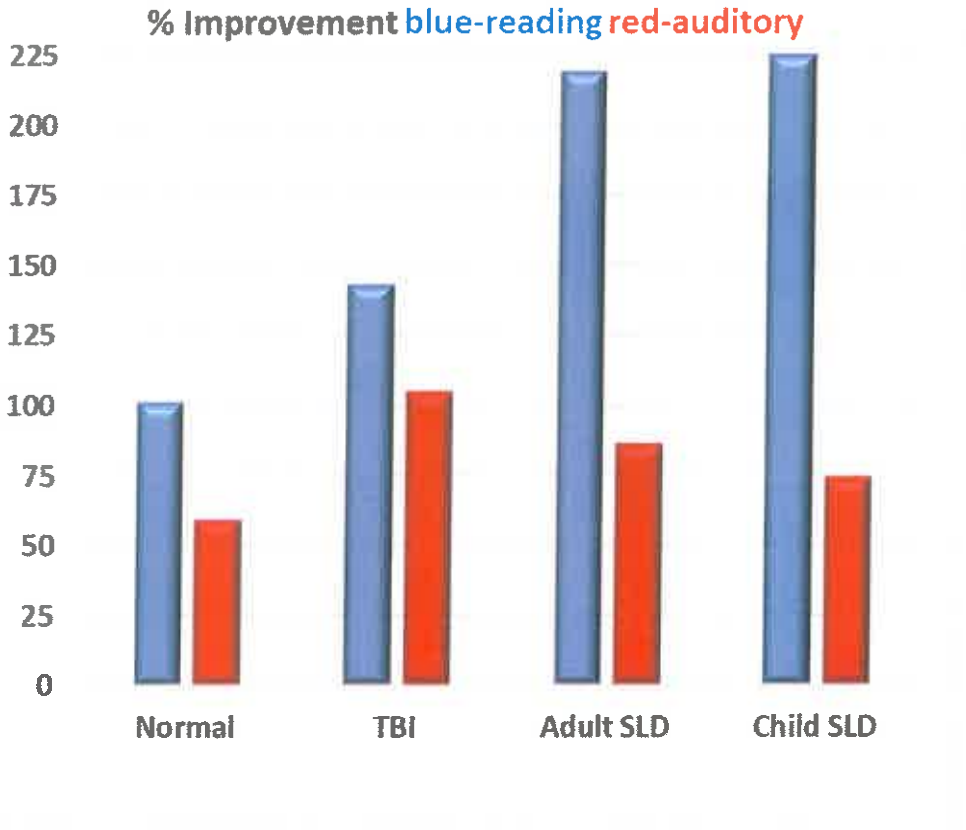


Figure 12 – Auditory Memory – improvement to above normative values

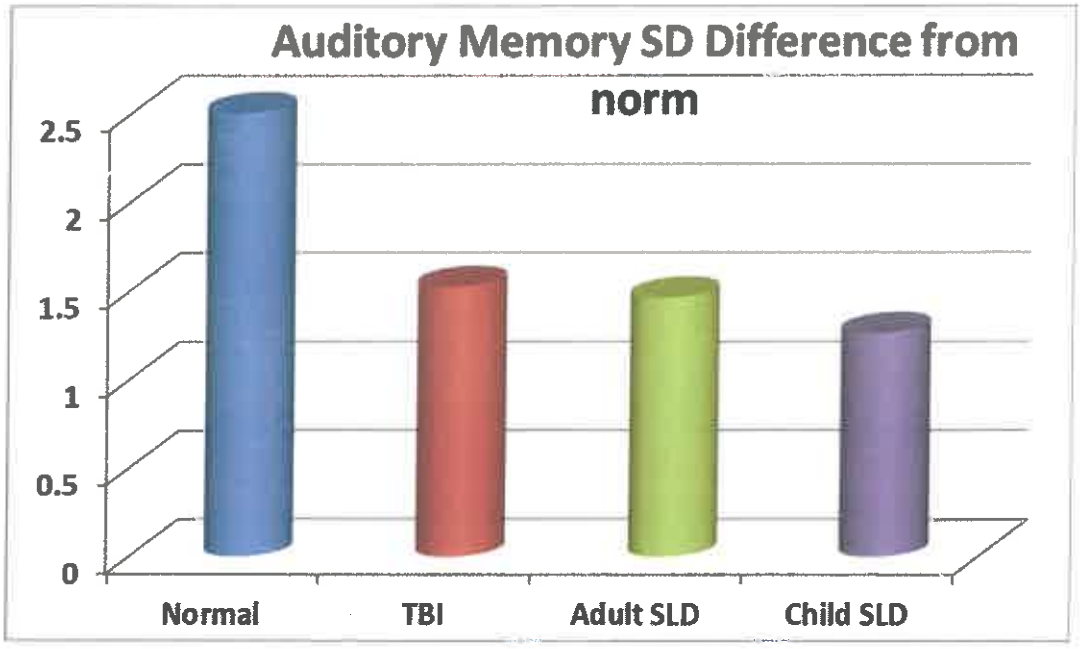
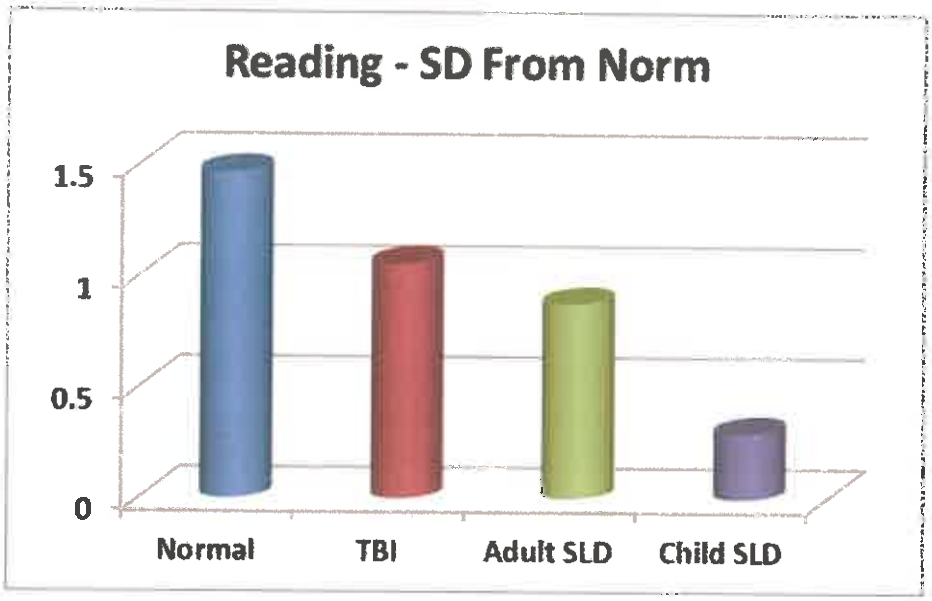


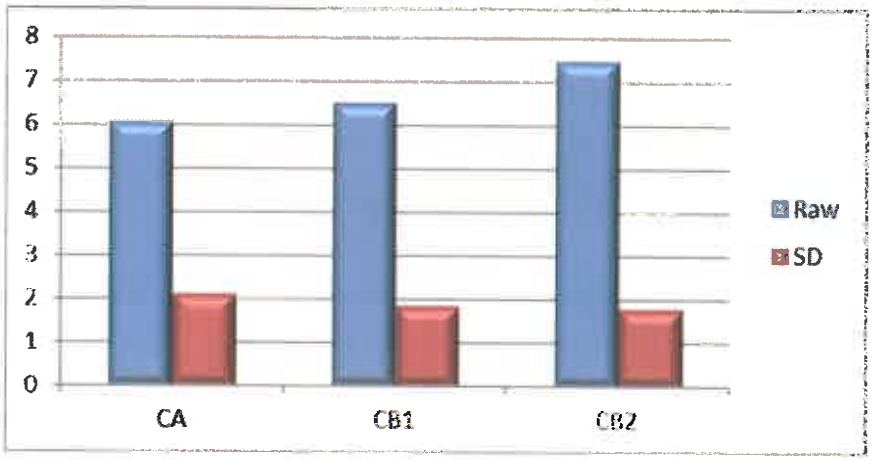
Figure 13 – Reading Memory – improvement to above normative values



Specific Changes in QEEG as a result of CAR interventions

Figure 14 shows the physical changes in the coherence values as a result of the interventions represented in standard deviation units.

Figure 14 – Raw Score and SD changes in coherence values



CA=Coherence Alpha; CB1=Coherence Beta1; CB2=Coherence Beta2

Significant results were also obtained for increases in relative power of beta2.

Automated Software

We have developed a highly automated cognitive activation QEEG evaluation which assesses 6 cognitive skills (auditory and visual attention, auditory and reading memory, working memory, problem-solving) while the QEEG data is collected. A subject's response pattern is compared to the normative database on all the variables and, specifically, those critical to success/failure on the specific cognitive skill. The automated expert system EEG biofeedback software addresses the deficit variables on a mathematically

prioritized basis, which is continually reevaluated as the subject goes thru the sessions. The performance is graphed at the end of the session and the data is saved for future analysis.

The technician's job is designed to be as simple as possible and requiring minimal knowledge of EEG and training (~5 days). The training is primarily (for the evaluation and feedback sessions) to place the cap on the head and obtain adequate impedance measurements. For the evaluation, the technician inputs demographic information, indicates when the subject has exhausted their recall and scores the subject's verbal recall (8 tasks). For the biofeedback sessions, the technician inputs the subject's name and the selects the cognitive task to be addressed. The software is designed to conduct the evaluation and biofeedback sessions with the most minimal technician involvement as possible. The approach has been granted a USPTO patent: QEEG Correlates of Effective Cognitive Functioning (memory and problem-solving) in Diverse Clinical Conditions, patent issued 2/27/2018, #9,901,279 B2. More information can be obtained at **Neuroeducation.co**.

Prison population – ADD, ADHD, TBI, Substance Abuse, Learning Disabilities

"15 studies from peer-reviewed journals show that 21-45% of prisoners have ADHD; ADHD subjects are 4 to 9 times more likely to commit crimes and go to jail; 46% of female prisoners in Rhode Island met criteria for childhood ADHD; A Swedish study showed 40% of adult male longer-term prison inmates had ADHD; The overall prevalence of ADHD in young male prisoners according to DSM-IV was 45%; For violent offending, ADHD symptoms were the strongest predictor followed by alcohol dependence."

http://adultaddstrengths.com/2011/01/12/adhd-and-crime-ignore-now-jail-later-15-clinical-studies/

"About 8.5 percent of U.S. non-incarcerated adults have a history of traumatic brain injury (TBI), and about 2 percent of the greater population is currently suffering from some sort of disability because of their injury. In prisons, however, approximately 60 percent of adults have had at least one TBI. In a recent South Carolina survey of 636 prisoners, some 65 percent of males and 73 percent of females reported having sustained TBIs at some point in their lives"

https://www.scientificamerican.com/article/traumatic-brain-injury-prison/

"Slaughter, Fann, and Ehde (2003) conducted standardized interviews with 69 randomly selected inmates in a county jail in Seattle, Washington. 87% percent of the subjects reported having had a TBI during their lifetime: 36.2% reported having had a TBI in the prior year.; It was noted that those with a more recent injury presented with a higher prevalence of anger, aggression, cognitive problems, and psychiatric problems at the time of the evaluation than those who had been injured previously. (Slaughter et al., 2003)

http://www.brainline.org/content/2009/05/traumatic-brain-injury-in-prisons-a-review_pageall.html

"Up to 50% of the prison population has some type of learning disability; Up to 60% of adolescents in treatment for substance abuse have learning disabilities; 31% of adolescents with learning disabilities will be arrested 3-5 years out of high school; 50% of juvenile delinquents tested were found to have undetected learning disabilities; 2/3 of all prisoners are below seventh grade in numeracy; 4/5 are below seventh grade in writing"http://odpc.ucsf.edu/sites/odpc.ucsf.edu/files/pdf_docs/REVISEDforensicpsychSQ.pdf Washington Summit on Learning Disabilities, 1994

This prison population analysis indicates that the special education child is particularly vulnerable to future problems. Many of these children also end up on the disability roles. All of these conditions have been shown to be responsive to EEG biofeedback interventions. I have recently published an article documenting that the effects of the treatment cannot be considered a placebo effect (Thornton, 2018).

Arns et al. (2014) meta-analysis incorporated 15 studies on neurofeedback from 2009 and found large effect sizes for inattention (.81 SD) and medium effects sizes (.55 SD) for hyperactivity and impulsivity. The effects did not disappear with time, and a tendency for further improvement across time for hyper-activity/impulsivity. Burkett et al. (2005) reported on 270 male addicts who received 30 EEG biofeedback sessions. Within the addict group, 53.2% reported no alcohol or drug use 12 months after biofeedback, and

23.4% used drugs or alcohol only one to three times after their stay. This was a substantial improvement from the expected 30% or less expected recovery in this group. Self-report depression scores dropped by 50% and self-report anxiety scores by 66%. Thornton (2013) reported on the memory improvements in the brain injured, normal and learning disabled groups indicated above normative values at the end of the treatment period.

It is important to note that jobs are not threatened by this technology, it merely requires about 5 days of retraining. The retraining will result in better outcomes and greater results from standard tutoring interventions. Start-up costs for one unit and training is $12,000 to $15,000. A small research grant could obtain the financial requirement. The cost of a 40 session program, after initial equipment and software costs, is $500. As a clinician and researcher, I can only bring you the research results which I believe will help these children. Much of academic research is in the pursuit of better options and understanding and not implementation. It is generally argued in educational discussions that the earlier you can effectively intervene, the greater the rewards for society and the individual. None of the tutoring interventions have shown decreases in impulsivity.

For the relevant articles that I have published you can go to http://neuroeducation.co/research-articles/ or http://neuroeducation.co/wp-content/uploads/2018/03/Thornton3318.pdf for a resume.

The Chinese have been actively involved in this technology.
https://www.wsj.com/video/under-ais-watchful-eye-china-wants-to-raise-smarter-students/C4294BAB-A76B-4569-8D09-32E9F2B62D19.html?mod=djemfoe

EEG biofeedback has been implemented in a number of school systems across the US.
http://www.kassel.us/biofeedback-in-schools

This letter indicates that we can do much better with these children than we have been and will have significant implications for their future and society. However, it should be noted that the technology is not a magic wand. There are about 100 billion neurons in the human brain. Changing the brain takes time and some children don't respond as well as we want them to. My estimate of the lifetime cost of the ADD diagnosis is over $600,000 (Thornton, 2006). Figure 14 shows an example of a typical setup.

I envision your organization employing the method on a small scale (1 location) until you are convinced of its effectiveness and value.

I anticipate the following arguments against trying this approach.

1) It is experimental. There are over 2,000 articles on EEG biofeedback published since 1968, many attesting to its effectiveness. The CAR results have been replicated in 79 subjects.
2) It's an invasive medical procedure. The biofeedback field has been dominated by psychologists since its inception and approved by the FDA for relaxation purposes. It is a non-invasive intervention with none of the issues of side effects which face the drug approach. Nothing is entered into the system. The cap consists of small sponges soaked in salt water.
3) The effects are predominantly a placebo effect. That argument has been discredited in the Thornton (2019) study. You can download it from http://neuroeducation.co/research-articles/
4) Our special education personnel will lose their jobs. No! They only need to be retrained and their jobs will be easier and more rewarding.
5) It is too complicated. The evaluation and biofeedback sessions are entirely software administered. Treatment decisions are based up algorithms which prioritize the intervention based on standard deviation values and correlations. The technician's job is primarily to place the cap on the head and obtain an adequate EEG signal.
6) I can't anticipate every possible contrary argument, but the evidence is clear. If you have an argument I haven't covered, please email it to me. The children you deal with are depending upon you to do what is right! They do not know the research.

7) There maybe legal or bureaucratic issues which could be handled by a lawyer. You might want to discuss this approach with a parent and see what their response is. However, many schools have been able to implement this program without legal or bureaucratic issues.
8) From one point of view a school could save money over time, as a child wouldn't have to be in a special education program throughout their education years.
9) I am arguing for a basic change in how we approach the problem. We have been employing the "outside" approach for over 70 years and it has appeared to have reached its level of maximum effectiveness. We can change the brain itself!

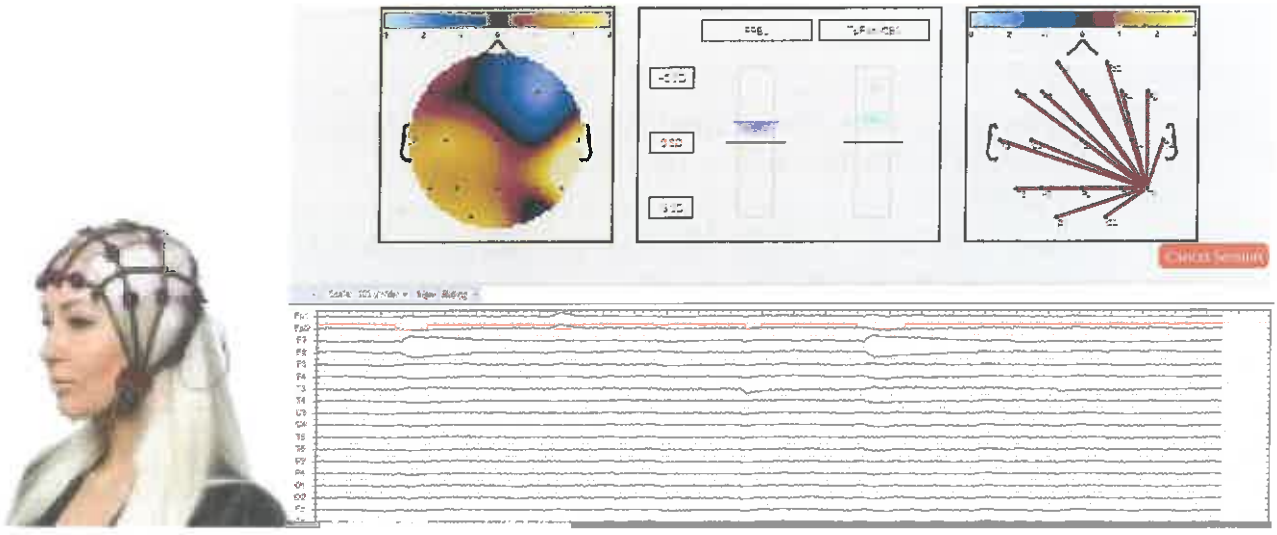
"I got a report on my son from his school. Beginning of 4th grade he was reading at a kindergarten level, now he is reading at a 2nd grade level with 98% accuracy and they predict he will be at 3rd grade level by the end of January! 😊"

Sincerely;

Kirtley Thornton, PhD

Figure 15 shows the standard EEG biofeedback screens and cap setup.

Figure 15



References

Arns, M et al. (2014). Evaluation of neurofeedback in ADHD: The long and winding road, *Biological Psychology*, 118, 108-115.

Bentum, K. W., & Aaron, P. G. (2003). Does reading instruction in learning disability resource rooms real work?: A longitudinal study. *Reading Psychology*, 24, 361-382. http://dx.doi.org/10.1080/02702710390227387

Burkett, S. V., Cummins, J. M., Dickson, R., & Skolnick, M. H. (2005). An open clinical trial utilizing real-time EEG operant conditioning as adjunctive therapy in the treatment of crack cocaine dependence. *Journal of Neurotherapy*, 9(2), 27–47.

Coben, R., Wright, E. K., Decker, S. L., Morgan, T. (2015). The impact of coherence neurofeedback on reading delays in learning disabled children: A randomized controlled study. *Neuroregulation*, Vol. 2 (4), 168-178. http://dx.doi.org.10.15540/nr.2.4.168

Eden, G. F., &Zeffiro, T. A. (1998). Neural systems affected in developmental dyslexia revealed by functional neuroimaging, *Neuron*, 21 (2), 279-282. http://dx.doi.org/10.1016/S0896-6273(00) 80537-1

http://adultaddstrengths.com/2011/01/12/adhd-and-crime-ignore-now-jail-later-15-clinical-studies/

https://www.scientificamerican.com/article/traumatic-brain-injury-prison/

Hellgren, L., Smauelsson, K., Lundqvist, A., Borsbo, B. (2015). Computerized Training of Working Memory for Patients with Acquired Brain Injury, Open Journal of Therapy and Rehabilitation, 46-55

Lindamood-Bell intervention program (2005) https://lindamoodbell.com/

Lindamood-Bell Learning Processes. (2005). Lindamood-Bell Learning Processes 2005 clinical statistics. Retrieved from http://lindamoodbell.com/downloads/pdf/research/clinical%20stats%202005.pdf

Linden, M., et.al. A Controlled Study of the Effects of EEG biofeedback on Cognition and Behavior of Children with Attention Deficit Disorder and Learning Disabilities. *Biofeedback and Self Regulation*, Vol. 21, No. 1, 1996

Lundqvist, A., Grundström, K., Samuelsson, K. and Rönnberg, J. (2010) Computerized Training of Working Memory in a Group of Patients Suffering from Acquired Brain Injury. Brain Injury, 24, 1173-1183. http://dx.doi.org/10.3109/02699052.2010.498007

McCandliss, B. D., & Noble, K.G. (2003). The development of reading impairment: a cognitive neuroscience model, *Mental Retardation and Developmental Disabilities Research Reviews*, 9 (3), 196-205. Http://dx.doi.org/10.1002/mrdd.10080

Othmer, S., & Othmer, S.F. (1992), EEG Biofeedback Training for Hyperactivity, Attention Deficit Disorder, Specific Learning Disability, and other Disorders, Handout EEG Spectrum, 16100 Ventura Blvd., Ste 100, Encino, Ca.

Ramus. F. (2004). Neurobiology of dyslexia: A reinterpretation of the data. *Trends in Neuroscience*, 27 (12). 720-726. http://dx.doi.org/10/1016/j.tins.2004.10.004

Ritchey, K. D., & Goeke, J. L. (2006). Orton-Gillingham and Orton-Gillingham-based reading Instruction: A review of the literature. *The Journal of Special Education*, 40(3), 171-183.

Rohling, M. L., Faust, M. E., Beverly, B. L., & Demakis, G. (2009). Effectiveness of cognitive rehabilitation following acquired brain injury: A meta-analytic re-examination of Cicerone et al.'s (2000, 2005) systematic reviews. Neuropsychology, 23(1), 20-39.

Shaywitz, S. E., & Sharwitz. B.A. (2004). Reading disability and the brain. *Educational Leadership*, 61 (6), 6-11.

Slaughter, B., Fann, J. R., & Ehde, D. (2003). Traumatic brain injury in a county jail population: Prevalence, neuropsychological functioning, and psychiatric disorders. *Brain Injury*, 17 (9), 731-741 http://www.brainline.org/content/2009/05/traumatic-brain-injury-in-prisons-a-review_pageall.html

Strong, G. K., Torgerson, C. J., Torgerson, D., & Hume, C. (2011). A systematic meta-analytic review Of evidence for the effectiveness of the "Fast ForWord" language intervention program. *Journal of Child Psychology and Psychiatry*, 52 (3),224-235. http://dx.doi.org/10.1111/j..1469-7610.2010.02329.x

Tansey, M. Wechsler (1991). (WISC-R) Changes Following Treatment of Learning Disabilities Via EEG Biofeedback Training in a Private Practice Setting. *Australian Journal of Psychology*, 43, 147-153.

Thompson, L. & Thompson, M. (1998), Neurofeedback combined with training in meta-cognitive Strategies: Effectiveness in students with ADD. *Applied Psychophysiology and Biofeedback*, 23 (4), 243-263.

Thornton, K. (2006). NCLB Goals (and more) are attainable with Neurocognitive Interventions, Vol. 1, Booksurge Press

Thornton, K. & Carmody, D. (2009). Traumatic Brain Injury Rehabilitation: QEEG Biofeedback Treatment Protocols, Applied Psychophysiology and Biofeedback, (34) 1, 59-68.

Thornton, K. & Carmody, D. (2013). The Relation between Memory improvement and QEEG changes in three clinical groups as a result of EEG biofeedback treatment, *Journal of Neurotherapy*, 17(2). 116-132.

Thornton, K. (2014). A QEEG activation methodology which obtains 100% accuracy in the Discrimination of traumatic brain injured from normal and does the learning disabled show the brain injury pattern?, *Neuroregulation*, 1 (3-4), 209-217.

Thornton, K. (2018). Perspectives on Placebo: The Psychology of Neurofeedback, NeuroRegulation, 5 (4), 137-149.

U.S. Department of Education, Institute of Educational Sciences (IES), 20010 https://ies.ed.gov/

Washington Summit on Learning Disabilities, 1994 http://odpc.ucsf.edu/sites/odpc.ucsf.edu/files/pdf_docs/REVISEDforensicpsychSQ.pdf

What Works Clearing House https://ies.ed.gov/ncee/wwc/

Wilson, B. A., &O'Conner, J.R. (1995). Effectiveness of the Wilson Reading System used in public School training. In C. McIntyre and J. Pickering (Eds.), *Clinical Studies of Multisensory Structured Language Education* (pp. 247-254). Salem, Or: International Multisensory Structured Language Education Council.

Wood, F. (2002). Wilson literacy solutions: Evidence of effectiveness. (unpublished data compilation Report). Oxford MA: Wilson Language training corp.

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April 8, 2020

I have recently come across the John Doe, et al., v. State of Ohio, et al., in the United States District Court, Southern District of Ohio, Eastern Division, Case No. 2:91-cv-464. I believe I have some information that may be of some help to all involved in this process.

In summary, the court has order that the school improve the performance (to the normal, healthy range) of the cognitive and mental health issues of the special education student. However, 1) there is insufficient current research evidence that any currently employed interventions can accomplish that task from a neuropsychological viewpoint; 2) there is no long term double bind research structure ("accredited research standards") built into the proposal that will accurately assess any effects of the changes the schools may make; 3) the structure relies upon local school personnel to render opinions as to the effectiveness of any intervention changes; 4) given the problems of eye witness testimony and inherent bias this approach is scientifically invalid; 5) there is an intervention option (EEG biofeedback) which has shown the ability to improve the cognitive abilities of the learning disabled student to above normal neuropsychological levels (in terms of reading and auditory memory).

The mandate of the courts is to improve "the achievement of students with disabilities and their inclusion in regular classrooms….identify barriers to achievement, including LRE (least restrictive environment) and **strategies to overcome these barriers…decisions are made on an individualized basis… focus on improving language and literacy**, including early literacy, for students with disabilities… including continuing to offer guidance regarding the Target Districts' responsibilities for providing IDEA "related services" that address a student's mental health needs….increased focus on language and literacy
The Plan will be informed by evidenced-based strategies and include:
a. Measures designed to achieve the existing, or updated, SPP (ODE's Part B State Performance Plan (SPP)) indicators for achievement and LRE beginning in the second year of this Agreement, for each of the Target Districts."

Thus, the court has ordered the school system to improve their results concerning the cognitive and mental health problems of their students who are in need of improvement in these areas and employ accredited research standards in evaluating the results. There is no "accredited research standards" built into the court's decision. One view of the court's decision is that they want the special education child to become "normal" and be able to function and survive in the real world. Graduation rates, while one measure, are not the ultimate goal, as this measure is predominantly an achievement measure and not an ability measure. We need to document both increases in achievement and ability. The implied and ultimate goal is for the child's cognitive and mental health issues to be functioning in the normal range. In my opinion, this can best be determined by neuropsychological measures and analysis of the electrophysiology of the child's brain.

The websites of the schools in question were examined for their currently employed approaches. There was no research cited or any information on what research documented

intervention model they are employing, other than using IEPs as the guiding tool. The following statements were made on the respective websites.

"Services are provided in accordance with each student's Individual Education Plan (IEP).... Our goal is to use current student information and data to craft and implement meaningful Individual Education Plans that activate engagement, increase student learning, and decrease barriers in all environments.... The department provides strong instructional supports and early intervening services that assist children in reaching their highest potential by:

Improving academic achievement", and the statements continue.

These statements provide no specific research reports of the interventions, thus there is no way for a parent to judge whether the interventions have demonstrable results and what are those results. This type of information would not enable a parent to judge whether they want their child involved in the program.

Thus, the question needs to be raised whether IEP guided interventions are effective, a difficult question to answer. In his article Classroom Research and Cargo Cults, Hirsch (2002) asserts that educational research is generally inconclusive: "The process of generalizing directly from classroom research is inherently unreliable" (p. 53). Hocutt (1996) concluded that "Most of these interventions show some promise, though none show dramatic or consistent success for all or even most students."

The problem facing the school system is what interventions will accomplish these goals. The critical value to examine in reviewing the research is Effect Size, as determined by the standard deviation change on standardized tests as a result of the intervention in a well-designed control group type research.

Supportive verbal opinion statements (from teachers, parents) are not a sufficient basis for scientific proof. The court mandated review process does not request standardized testing during the process but rather "The Advisory group will provide updates to the Target Districts Advisory Group as to its development and implementation of the Plan no less than on a quarterly basis and the Target Districts Advisory Group may make suggestions to ODE on the implementation of the Plan." Will they be based upon conversations and opinions from school personnel rather than periodic testing which avoids / takes into account the problem of repeat testing and practice effects? Asking school personnel to be judges of the progress is asking for biased witnesses to report on an event. An independent (Plaintiff hired – Ohio State paid) staff needs to be hired to administer a short neuropsychological batteries (to a random sample of subjects) assessing memory, attention, problem solving, etc. on a 6 or 12 month basis. This approach is the preferred method to determine if progress is being made. I received a recent statement from a Board member of a school (not in Ohio) who stated that he was told, by the Board's president, to not talk to the general public but tell them everything was fine and, in essence, smile (his words). The review structure does not protect against this type of attitude. Scientific proof relies on blind assessments. The recommended structure is a violation of that tenet. In addition, there is no built in structure to assess the long term effectiveness of the court's decision. Apart from reviewing comments provided by local school personnel, there is no double blind control group structure to the proposed intervention. Thus, no matter what happens there will be no valid scientific conclusion as to its effectiveness.

Unfortunately, the verbal statements presented in the judge's decision do not indicate how the schools are supposed to accomplish this task. The available research reports, I will refer to, do not provide strong evidence that the goal can be obtained efficiently and inexpensively. "The review covered 66 programs with an average effect size of .27 SD (standard deviation).

(range 0-.87). Reading rescue (SD=.89) costs $10-$15 K a year for about 95 30-minute sessions." ($105 per 30 minutes) If we repeat the intervention, will we obtain another .89 SD improvement value? This is what the school system may be doing, repeating the same intervention and hoping to obtain an equal improvement to the first intervention. None of the interventions reported that they can increase the cognitive levels of the special education student to normal or above normal values.

I have been following this area of research for the past 25 years. It is my opinion, given the research I have reviewed, that the traditional tutoring / computer interventions will not be able to accomplish the task the court has ordered. The approaches the schools have been employing for years have not accomplished what needs to be accomplished and repeating the same approach without demonstratable changes is unrealistic. It is unrealistic to expect the schools to re-invent a new tutoring / computer intervention model, which is going to greatly surpass decades of research in this area. It is not the fault of the school's personnel. The problem is the technology they have available. It is insufficient to meet the needs of these children. What needs to be proved is the ability of the intervention to improve the cognitive abilities (neuropsychological measures). Ask the special education child how much they remember from a day in school and you will observe how limited their cognitive abilities are.

What is required is a method to change how the child's brain is working and thus their basic cognitive abilities, which will help them survive in the world. That is the goal of the judge's decision. The best way to obtain that goal is to change the special education child's brain to a normal level. Operant condition (rewarding / inhibiting of behavior) has a long and respected researched history of effectiveness. Tutors and teachers use the method to reward / inhibit the student for accurate / inaccurate responses. What has been clear over the past several decades is that the electrophysiology of the brain is responsive to operant conditioning. Researchers have been addressing the issue of what signals affect / control what behavior. We now know the electrophysiological signals involved in ADD, ADHD, learning disabilities and brain injuries. These important scientific advances have not been implemented in the school system. What is being done in the school system, for example, with head injuries is not our most effective approach given our state of scientific knowledge in this area (Figure 3 in attached document). We need to bring neuroscience into the school system! The neuroscience field has been exponentially growing for decades. The advances in the field need to be integrated into the school system.

I have attached a letter which addresses the use of the quantitative EEG and EEG biofeedback in the diagnosis and treatment of learning disabilities, the head injured and normal subjects. The 14 page argument present the research data, explains the reasoning behind the approach and argues for a basic change in how we address the cognitive issues in the SLD child and brain injured. Figure 1 shows a comparison between presently employed methods and the EEG biofeedback approach. The figure gives the benefit of the doubt to some programs. For example, FastForword has 3 independent studies indicating lack of effectiveness. The Orton-Gillingham effect for 2 of measures employed did not meet the criteria of confidence intervals and requires about 300 sessions. Figure 2 compares the approach to the best research reports currently available. Figure 3 shows the comparisons for interventions for the head injured subject. In all situations, the EEG biofeedback approach is significantly superior.

The recommended approach in the decision will be wasting several years overseeing what we already know is not giving us the results that the court has ordered. The other issue

involved in this issue is cost issues. The 14 page discussion presents a considerable cost savings approach with the EEG biofeedback approach with concomitant significantly better results. "The current average per student cost is $7,552 and the average cost per special education student is an additional $9,369 per student." (http://www.nea.org/home/19029.htm) The EEG biofeedback approach offers a massive reduction in this cost. The estimated cost after equipment purchase and training is $500 for 40 sessions (plus cost of technician time) (more may be required, some may not respond).

I propose we implement the EEG biofeedback approach in one or several schools to address what the court has requested. "A provision for modifying the Plan, if improvements are not occurring. Any modifications will be informed by evidence-based strategies."

A control group comparison (double bind procedure) could be employed using the school systems that are not employing the EEG biofeedback approach, thus providing a definitive answer regarding What Works.

I would like to present the EEG biofeedback information to the parents (via internet) who could be involved in the program to determine their possible interest in having their children participate. The court's recommendations do not involve the parents, a key group in this decision on how to advance.

In conclusion, the court's goal of improving the cognitive and mental health issues of the special education child cannot be met with the current technology employed and the structure of the intervention doesn't allow for an objective assessment of any intervention the schools may pursue. There is a viable option, EEG biofeedback, which appears to have the best chance (not guaranteed for all subjects) of obtaining the goal of the court's decision.

The research proposal would require approval from an IRB board and would need to address Helsinki recommendations regarding research (medical) which, in general, argue against withholding an effective treatment for a condition.

Sincerely;

Kirtley Thornton, PhD.

References

Hirsch, E. D., Jr. (2002). Classroom research and cargo cults. *Policy Review,* 51-69.

Hocutt, A. (1996). Effectiveness of Special Education: Is Placement the Critical Factor? The Future of Children SPECIAL EDUCATION FOR STUDENTS WITH DISABILITIES. 6 (1)

Spaulding, L.S. (2009). Best Practices and Interventions in Special Education: How do we Know What works?, Teaching Exceptional Children Plus, 5 (3), http://escholarship.bc.edu/education/tecplus/Vol5,iss3/art2

Addendum to recent Ohio decision discussion

I would like to add a few points to the discussion of the Ohio state decision I sent out the other day. A distinction needs to made between achievement and ability. The battery proposed appears to be predominantly an achievement battery as indicated by Ms. Sjoberg.

Kerstin Sjoberg, Disability Rights Ohio Executive Director. "We have worked diligently with our partners and collaboratively with the Ohio Department of Education to reach a comprehensive settlement that delivers what the law requires, a free appropriate public education for students with disabilities. The plan will **enhance academic achievement**, promote inclusion and improve the supports students with disabilities receive in school. After years of litigation, this settlement will improve outcomes for students with disabilities in real and concrete ways and that is cause for celebration." The measure relies upon the Prepared-for-Success-Component.

Neuropsychological measures measure ability. Although the two are related they are not the same. While competence in and knowledge of a field (achievement) are important it is the abilities of the subject to adapt and continue to learn that are critical, as all fields are rapidly changing in today's technological word (neuropsychology measures). Thus, measuring and addressing this variable is critical.

Design suggestions to the proposal would include the neuropsychological battery pre and post intervention to assess ability issues (not achievement). We have available computerized assessments of the cognitive abilities for memory (reading, auditory), attention (visual, auditory) and problem solving. The battery would also assess the quantitative EEG values and changes. We could obtained appropriate control group values from the normal population which can be used to assess progress and serve as a control group. Other design changes can be considered, such as including both achievement and ability measures.

Sincerely;

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Published Research

Neuropsychology of Sex Offenders. ***Journal of Offender Rehabilitation.*** **Jan. 1991**

The Anatomy of The Lie: An Exploratory Investigation via the quantitative EEG. ***Journal of Offender Rehabilitation,*** **1995, 22 (3/4), 179-185.**

On the Nature of Artifacting the qEEG. ***Journal of Neurotherapy,*** **1 (3), 1996, 31-40.**

The Fig Technique and the Functional Structure of Memory in Head Injured and Normal Subjects. ***Journal of Neurotherapy,*** **2 (1), 1997, 23-43.**

Exploratory Investigation into Mild Brain Injury and Discriminant Analysis with High Frequency Bands (32-64 Hz), ***Brain Injury,*** **August, 1999, 477-488.**

Exploratory Analysis: Mild Head Injury, Discriminant Analysis with High Frequency Bands (32-64 Hz) under Attentional Activation Conditions & Does Time Heal?. ***Journal of Neurotherapy,*** **Feb., 2000, 3 (3/4) 1-10.**

Electrophysiology of Auditory Memory of Paragraphs. ***Journal of Neurotherapy,*** **2000, Vol 4(3), 45-73.**

Rehabilitation of Memory Functioning in Brain Injured Subjects with EEG Biofeedback. ***Journal of Head Trauma Rehabilitation,*** **Dec., 2000, 15 (6), 1285-1296.**

Rehabilitation of Memory functioning with EEG Biofeedback. ***Neurorehabilitation,*** **2002, Vol. 17 (1), 69-81.**

Electrophysiology of Visual Memory for Korean Characters. ***Current Psychology,*** **Spring 2002, Vol. 21, No. 1, 85-108.**

Electrophysiology of the reasons the brain damaged subject can't recall what they hear. ***Archives of Clinical Neuropsychology,*** **2003, 17, 1-17.**

Electrophysiology (QEEG) of Effective Reading Memory: Towards a Generator/Activation Theory of the Mind. ***Journal of Neurotherapy, 2002,*** **6(3), 3 7-66.**

A Cost/Benefit Analysis of Different Intervention Models for the LD/Special Education Student, ***Biofeedback,*** **Winter, 2004, 9-13.**

Thornton, K. & Carmody, D. (2005). EEG Biofeedback for Reading Disabilities and Traumatic Brain Injuries. ***Child and Adolescent Psychiatric Clinics of North America,*** **Jan., 137-162.**

Subtype Analysis of Learning Disability by Quantitative Electroencephalography Patterns, ***Biofeedback,*** **2006, 34 (3), 106-113.**

The qEEG in the Lie Detection Problem; The Localization of Guilt, ***J. of Neurotherapy, 2006***

Reading Disability from the Activation Database Point of View, ***Neuroconnections,*** **May, 2007, 9- 11.**

Thornton, K. & Carmody, D. (2008). Efficacy of Traumatic Brain Injury Rehabilitation: Interventions of QEEG-Guided Biofeedback, Computers, Strategies, and Medications, ***Applied Psychophysiology and Biofeedback,*** **(33) 2, 101-124.**

Thornton, K. & Carmody, D. (2009). Eyes-Closed and Activation QEEG Databases in predicting Cognitive Effectiveness and the Inefficiency Hypothesis, ***Journal of Neurotherapy,*** **(13) 1,1-22**

Thornton, K. & Carmody, D. (2009). Traumatic Brain Injury Rehabilitation: QEEG Biofeedback Treatment Protocols, ***Applied Psychophysiology and Biofeedback,*** **(34) 1, 59-68.**

Thornton, K, Carroll, C. (2010). The Coordinated Allocation of Resource (CAR) Model Intervention for Reading, Problems in two clinics, ***Neuroconnections,*** **Fall, 8-16.**

Thornton, K.E. & Carmody, D.P. (2012). Symbol Digit and the Quantitative EEG, ***Journal of Neurotherapy,*** **16:3, 210-222.**

Thornton, K. (2014). A QEEG activation methodology which obtains 100% accuracy in the discrimination of traumatic brain injured from normal and does the learning disabled show the brain injury pattern?, ***Neuroregulation,*** **1 (3-4), 209-217.**

Thornton, K. & Carmody, D. (2013). The Relation between Memory improvement and QEEG changes in three clinical groups as a result of EEG biofeedback treatment, ***Journal of Neurotherapy,*** **17(2). 116-132.**

Thornton, K., Carmody, D., (2014). The Coordinated Allocation of Resource (CAR) Electrophysiological Patterns of Recalling Names of Faces in Children, Adolescents and Adults and the Central Processing Unit (CPU) of the Brain, Neuroregulation, 1(1), 87-104.

Thornton, K. (2016). Neurotherapy and Connectivity, Biofeedback. Volume 44, Issue 4, pp. 218-224

Thornton, K. (2018). Perspectives on Placebo: The Psychology of Neurofeedback, NeuroRegulation, 5 (4), 137-149.

Book Chapters

Thornton, K. (2004). Ch. 95, Cognitive Rehabilitation and Neuronal Plasticity, In Roberts, A. & Yaeger, K. (eds). *Evidence Based Practice Manual*, 857- 881. Oxford University Press

Thornton, K. & Carmody, D. (2009). Chapter Title: Traumatic Brain Injury and the Role of the Quantitative EEG in the assessment and remediation of cognitive sequelae. In Roland A. Carlstedt PhD (ed). *Integrative Clinical Psychology, Psychiatry and Behavioral Medicine: Perspectives, Practices and Research*, 463-508. Springer Publishing Company, Dec 14, 2009 - 912 pages

Thornton, K. (2013). Traumatic Brain Injury, the Quantitative EEG and EEG biofeedback, accepted for publication, AAPB publication

Thornton, K. (2013) Chapter Title: The Role of the quantitative EEG in the diagnosis and rehabilitation of the traumatic brain injured patient, *Concussions in Athletics: From Brain to Behavior*, Chapter 18, 463-5083, Eds. Semyon M. Slobounov and Wayne Sebastianelli, Springer publ., NY, NY

Thornton, K., Carmody, D., (2015). The Electrophysiological Coordinated Allocation of Resource (CAR) Model of Effective Reading in Children, Adolescents and Adults, T.F. Collura & J. Frederick, (Eds.) *Clinician's Companion to QEEG and Neurofeedback*. New York: Routledge

***Book:* NCLB Goals (and more) are attainable with Neurocognitive Interventions, Vol. 1, Booksurge Press, 2006**

How the Cognitive Brain Works: The Quantitative EEG and Cognition, Create Space, 2016 (a compilation of 15 articles addressing the relationship between cognition and the QEEG)

***Consultant*: Traumatic Brain Injury Grant Reviewer: Department of Defense, 3/2012; 12/2008; Federal Grant Reviewer, May, 2009**

Certification:

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Patents

QEEG Correlates of Effective Cognitive Functioning (memory and problem solving) in Diverse Clinical Conditions, patent issued 2/27/2018, #9,901,279 B2

Nominations:

1. **1998** Thomas A. Edison Patent of the Year Award
2. **June, 2002** Award for Distinguished Professional Contributions to Independent or Institutional Practice in the Private Sector
3. **May, 2004** Award for Distinguished Contributions of Applications of Psychology to Education and Training
4. **2004** New Abilities Foundation Award for Best New Freedom Product or Technology (considered by supporters as the Nobel Peace prize award in the area of disabilities)
5. **Aug., 2005** North American Brain Injury Society Innovations in Treatment Award

Awards:

Sept., 2009 Joseph Lubar Award for contributions to Neurotherapy, awarded by ISNR

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United States Marshals Service

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